



phosphoglycerate kinase deficiency

Phosphoglycerate kinase deficiency is a genetic disorder that affects the body's ability to break down the simple sugar glucose, which is the primary energy source for most cells. Researchers have described two major forms of the condition. The most common form is sometimes called the hemolytic form. It is characterized by a condition known as chronic hemolytic anemia, in which red blood cells are broken down (undergo hemolysis) prematurely. Chronic hemolytic anemia can lead to unusually pale skin (pallor), yellowing of the eyes and skin (jaundice), fatigue, shortness of breath, and a rapid heart rate. Some people with the hemolytic form also have symptoms related to abnormal brain function, including intellectual disability, seizures, and stroke.

The other form of phosphoglycerate kinase deficiency is often called the myopathic form. It primarily affects muscles, causing progressive weakness, pain, and cramping, particularly with exercise. During exercise, muscle tissue can be broken down, releasing a protein called myoglobin. This protein is processed by the kidneys and released in the urine (myoglobinuria). If untreated, myoglobinuria can lead to kidney failure.

Most people with phosphoglycerate kinase deficiency have either the hemolytic form or the myopathic form. However, other combinations of signs and symptoms (such as muscle weakness with neurologic symptoms) have also been reported.

Frequency

Phosphoglycerate kinase deficiency appears to be a rare disorder. About 30 families with affected members have been reported in the scientific literature.

Genetic Changes

Phosphoglycerate kinase deficiency is caused by mutations in the *PGK1* gene. This gene provides instructions for making an enzyme called phosphoglycerate kinase, which is involved in a critical energy-producing process in cells known as glycolysis. During glycolysis, the simple sugar glucose is broken down to produce energy.

Mutations in the *PGK1* gene reduce the activity of phosphoglycerate kinase, which disrupts energy production and leads to cell damage or cell death. It is unclear why this abnormality preferentially affects red blood cells and brain cells in some people and muscle cells in others. Researchers speculate that different *PGK1* gene mutations may have varying effects on the activity of phosphoglycerate kinase in different types of cells.

Inheritance Pattern

This condition is inherited in an X-linked recessive pattern. The *PGK1* gene is located on the X chromosome, which is one of the two sex chromosomes. In males (who have only one X chromosome), one altered copy of the gene in each cell is sufficient to cause the condition. In females (who have two X chromosomes), a mutation would have to occur in both copies of the gene to cause the disorder. Females with one altered *PGK1* gene, however, may have some features of phosphoglycerate kinase deficiency, such as anemia. A characteristic of X-linked inheritance is that fathers cannot pass X-linked traits to their sons.

Other Names for This Condition

- PGK deficiency
- PGK1 deficiency
- phosphoglycerate kinase 1 deficiency

Diagnosis & Management

Genetic Testing

- Genetic Testing Registry: Deficiency of phosphoglycerate kinase
<https://www.ncbi.nlm.nih.gov/gtr/conditions/C0684324/>
- Genetic Testing Registry: Phosphoglycerate kinase 1 deficiency
<https://www.ncbi.nlm.nih.gov/gtr/conditions/C1970848/>

Other Diagnosis and Management Resources

- Children Living with Inherited Metabolic Diseases (CLIMB) (UK): Phosphoglycerate Kinase Deficiency
<http://www.climb.org.uk/IMD/Papa/PhosphoglycerateKinaseDeficiency.pdf>

General Information from MedlinePlus

- Diagnostic Tests
<https://medlineplus.gov/diagnostictests.html>
- Drug Therapy
<https://medlineplus.gov/drugtherapy.html>
- Genetic Counseling
<https://medlineplus.gov/geneticcounseling.html>
- Palliative Care
<https://medlineplus.gov/palliativecare.html>
- Surgery and Rehabilitation
<https://medlineplus.gov/surgeryandrehabilitation.html>

Additional Information & Resources

MedlinePlus

- Encyclopedia: Hemolytic Anemia
<https://medlineplus.gov/ency/article/000571.htm>
- Health Topic: Anemia
<https://medlineplus.gov/anemia.html>
- Health Topic: Carbohydrate Metabolism Disorders
<https://medlineplus.gov/carbohydratemetabolismdisorders.html>
- Health Topic: Genetic Brain Disorders
<https://medlineplus.gov/geneticbraindisorders.html>
- Health Topic: Muscle Disorders
<https://medlineplus.gov/muscledisorders.html>

Genetic and Rare Diseases Information Center

- Phosphoglycerate kinase deficiency
<https://rarediseases.info.nih.gov/diseases/7389/phosphoglycerate-kinase-deficiency>

Educational Resources

- Disease InfoSearch: Phosphoglycerate kinase 1 deficiency
<http://www.diseaseinfosearch.org/Phosphoglycerate+kinase+1+deficiency/5733>
- European Network for Rare and Congenital Anemias (ENERCA)
<http://www.enerca.org/anaemias/40/phosphoglycerate-kinase-deficiency>
- MalaCards: phosphoglycerate kinase deficiency
http://www.malacards.org/card/phosphoglycerate_kinase_deficiency
- Neuromuscular Disease Center, Washington University
<http://neuromuscular.wustl.edu/msys/glycogen.html#pgk>
- Orphanet: Glycogen storage disease due to phosphoglycerate kinase 1 deficiency
http://www.orpha.net/consor/cgi-bin/OC_Exp.php?Lng=EN&Expert=713

Patient Support and Advocacy Resources

- Children Living with Inherited Metabolic Diseases (CLIMB) (UK)
<http://www.climb.org.uk/>
- Muscular Dystrophy Association
<https://www.mda.org/disease/metabolic-diseases-of-muscle>

- National Organization for Rare Disorders (NORD)
<https://rarediseases.org/rare-diseases/phosphoglycerate-kinase-deficiency/>
- Resource list from the University of Kansas Medical Center: Metabolic Conditions
<http://www.kumc.edu/gec/support/metaboli.html>

ClinicalTrials.gov

- ClinicalTrials.gov
<https://clinicaltrials.gov/ct2/results?cond=%22phosphoglycerate+kinase+deficiency%22>

Scientific Articles on PubMed

- PubMed
<https://www.ncbi.nlm.nih.gov/pubmed?term=%28%28phosphoglycerate+kinase+deficiency%5BTIAB%5D%29+OR+%28PGK+deficiency%5BTIAB%5D%29%29+AND+english%5Bla%5D+AND+human%5Bmh%5D>

OMIM

- PHOSPHOGLYCERATE KINASE 1 DEFICIENCY
<http://omim.org/entry/300653>

Sources for This Summary

- Aasly J, van Diggelen OP, Boer AM, Brønstad G. Phosphoglycerate kinase deficiency in two brothers with McArdle-like clinical symptoms. *Eur J Neurol.* 2000 Jan;7(1):111-3.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/10809925>
- Beutler E. PGK deficiency. *Br J Haematol.* 2007 Jan;136(1):3-11. Review.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/17222195>
- Flanagan JM, Rhodes M, Wilson M, Beutler E. The identification of a recurrent phosphoglycerate kinase mutation associated with chronic haemolytic anaemia and neurological dysfunction in a family from USA. *Br J Haematol.* 2006 Jul;134(2):233-7. Epub 2006 Jun 1.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/16740138>
- Noel N, Flanagan JM, Ramirez Bajo MJ, Kalko SG, Mañú Mdel M, Garcia Fuster JL, Perez de la Ossa P, Carreras J, Beutler E, Vives Corrons JL. Two new phosphoglycerate kinase mutations associated with chronic haemolytic anaemia and neurological dysfunction in two patients from Spain. *Br J Haematol.* 2006 Feb;132(4):523-9. Erratum in: *Br J Haematol.* 2006 May;133(4):451. Flanagan, John [corrected to Flanagan, Jonathan M]; Perez de la Ossa, Pablo [added]; Carreras, Josep [added].
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/16412025>
- Sotiriou E, Greene P, Krishna S, Hirano M, DiMauro S. Myopathy and parkinsonism in phosphoglycerate kinase deficiency. *Muscle Nerve.* 2010 May;41(5):707-10. doi: 10.1002/mus.21612.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/20151463>

- Spiegel R, Gomez EA, Akman HO, Krishna S, Horovitz Y, DiMauro S. Myopathic form of phosphoglycerate kinase (PGK) deficiency: a new case and pathogenic considerations. *Neuromuscul Disord*. 2009 Mar;19(3):207-11. doi: 10.1016/j.nmd.2008.12.004. Epub 2009 Jan 20. *Citation on PubMed*: <https://www.ncbi.nlm.nih.gov/pubmed/19157875>
 - Svaasand EK, Aasly J, Landsem VM, Klungland H. Altered expression of PGK1 in a family with phosphoglycerate kinase deficiency. *Muscle Nerve*. 2007 Nov;36(5):679-84. *Citation on PubMed*: <https://www.ncbi.nlm.nih.gov/pubmed/17661373>
-

Reprinted from Genetics Home Reference:

<https://ghr.nlm.nih.gov/condition/phosphoglycerate-kinase-deficiency>

Reviewed: December 2011

Published: March 21, 2017

Lister Hill National Center for Biomedical Communications
U.S. National Library of Medicine
National Institutes of Health
Department of Health & Human Services